Bellcomm

955 L'Enfant Plaza North, S.W.
Washington, D. C. 20024

date: August 26, 1971

to: Distribution

B71 08037

from: J. J. O'Connor

subject: Apollo 16 210' Dish Coverage - Case 320

ABSTRACT

Continuous TV coverage during Rover traverses would be enhanced if we could obtain the 8 dB improvement a 210' dish gives over an 85' dish. Using Apollo 16 launch dates and the Apollo 15 nominal lunar timeline a chart was prepared to show the Goldstone 210' dish coverage of the three Rover EVA's for the nominal, L+1 and L+2 launch months. The coverage from Parkes and Jodrell Bank are also shown. It appears that only about 50 percent coverage is available from Goldstone but it is believed that this could be significantly increased by adjustment of the LM touchdown time and lunar timeline.

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MEMORANDUM FOR FILE

INTRODUCTION

In examining the possibility of continuous TV coverage during Rover traverses,[1] the earth-received signal strength is an important parameter. The 8 dB improvement in the 210' dish over the 85' dish makes its use attractive. The question, then, is do we have coverage.

To examine this problem, we looked at the Apollo 16 mission as it is now planned.[2] The nominal launch day of March 17, 1972, was assumed and this determined the LM touchdown time as shown on Figure 1. At this point the nominal lunar timeline of Apollo 15 was used. Also shown on Figure 1 is the Goldstone 210' dish coverage (moon above 5° of the local horizon at Goldstone).

GOLDSTONE COVERAGE

It is seen that the Goldstone coverage has a 55 percent duty cycle for this time of year due to its latitude. However, there is only 50 percent coverage of the EVA's: all of the first one, half of the second one and none of the third one. The basic problem is that the coverage has a period of 25 hours while that of the EVA's is only 21 hours and they tend to drift apart. Exact synchronization is not necessary for a few EVA periods since the coverage periods are longer than the EVA periods. For example, complete coverage could be obtained if the EVA period was extended to 22 hours and the second EVA occurred exactly in the middle of the coverage period.

There is some adjustment of the phasing between the EVA's and the coverage periods by selection of the LM touchdown time. For example, the touchdown time could be delayed by 2.9 hours where the LM Descent Propulsion System abort limit is reached. It could be advanced at the

expense of lower sun angles at touchdown; reduction to 7° would give 5.2 hours advance. This is shown in the top part of Figure 2. Again examining Goldstone coverage, it is seen that earlier touchdown times do not help but the maximum delay of touchdown time increases coverage to 61%. The complete coverage mentioned in the previous paragraph would be a 6.5 hour touchdown delay and 22 hour EVA periods.

OTHER COVERAGE

Also shown on Figure 2 is the coverage for Parkes, Australia. It has a low duty cycle of 13 percent because of its latitude but also because of structural limitations which require elevation angles greater than 30° above the local horizon. This Parkes coverage helps not a bit. While it does not presently have the equipment for Apollo TV reception, Jodrell Bank has interesting coverage; its 62 percent duty cycle just happens to give complete coverage of the three (nominal) EVA's.

L+1 AND L+2 LAUNCH DATES

Figure 2 also shows the coverage for contingence launches in the months of April and May, 1972. It is seen that there is a drift between the coverage periods and the touchdown time, which is different for each launch month, also the duty cycles of each station change, as seen in the table below.

PERCENT DUTY CYCLE OF SITE COVERAGE

	1972 LAUNCH MONTH		
STATION	MARCH	APRIL	MAY
Goldstone	55	50	46
Parkes	13	24	29
Jodrell Bank	62	53	47

Examination of these contingence months shows approximately the same results. Unfortunately Goldstone phasing went the wrong way (relative to the nominal EVA timeline) and it has a lower duty cycle. Parkes has bad phasing and too low a duty cycle. Jodrell Bank still has the best coverage.

SUMMARY

Unfortunately, this study of Apollo 16 210' coverage did not give an unqualified confirmation of this approach. Some coverage is available (about 50 percent) and this could be increased if the coverage requirement is entered as a constraint on the mission planning, along with all the other constraints. There is nothing in the April or May coverage which would warrant a schedule slip.

J. J. O'Connor

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Attachment
Figures 1 and 2
References

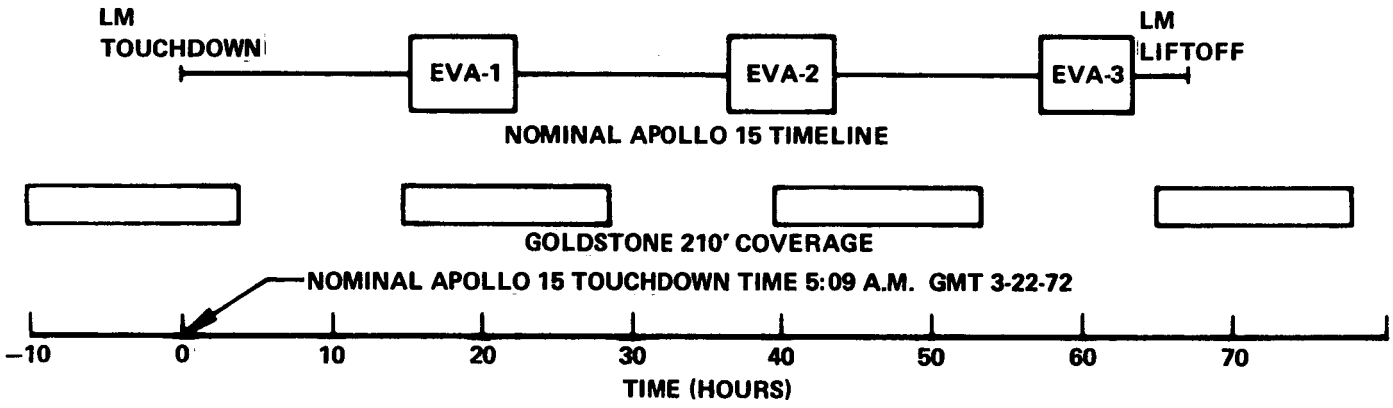

FIGURE 1 - GOLDSTONE COVERAGE OF APOLLO 16

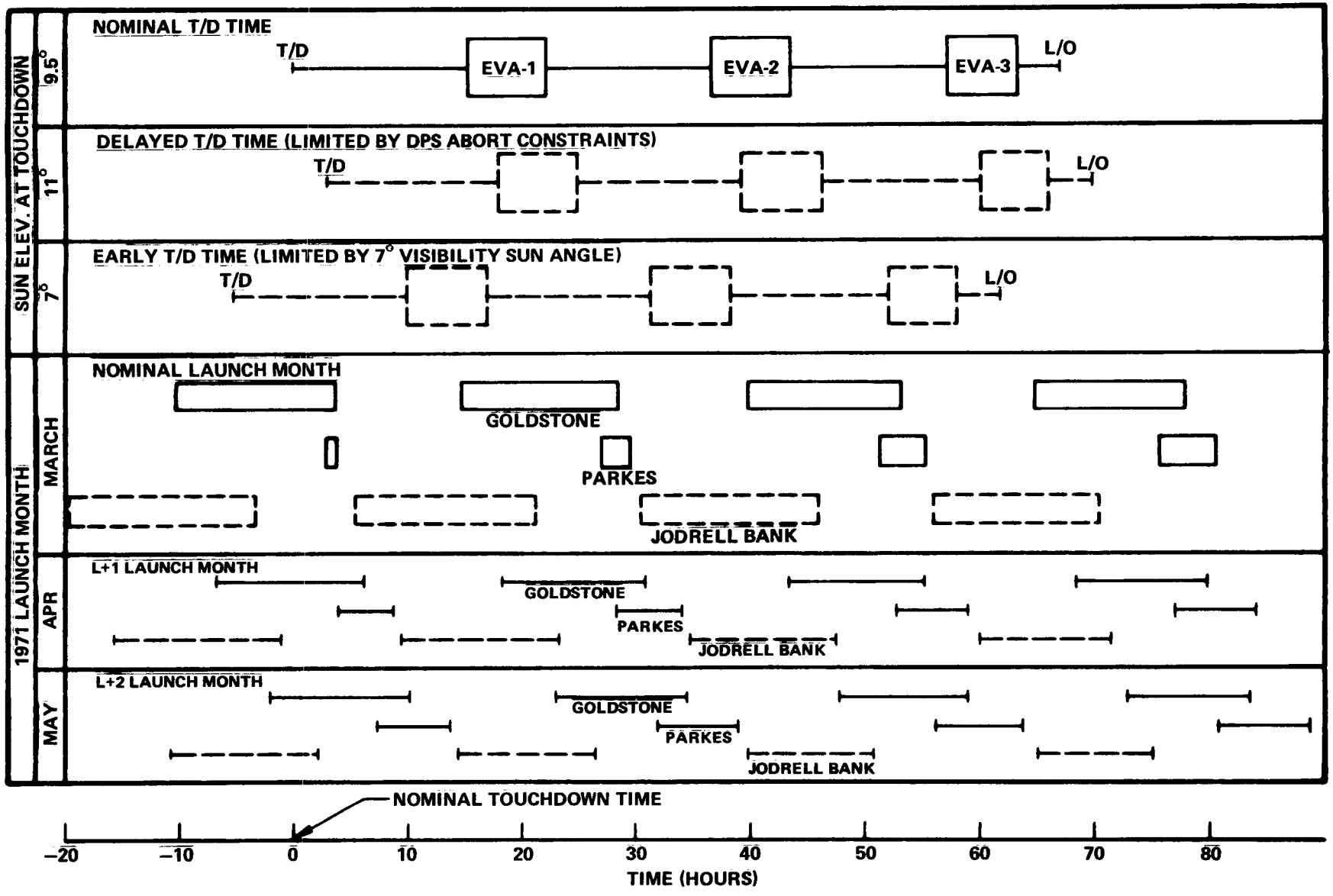

FIGURE 2 - APOLLO 16 210' COVERAGE POSSIBILITIES

REFERENCES

1. J. J. O'Connor, "On the Problem of Continuous Television During Rover Traverses", Case 320, Bellcomm Memorandum for File B71 08036, August 26, 1971.

2. R. J. Stern, "Minimum Feasible Sun Elevation for Apollo 16 T+24 Hour Launch Opportunities", Case 310, Bellcomm Memorandum for File B71-07044, July 28, 1971.